Every Student Counts

Middle School Professional Development Guide
Year 1 - Day 3

Iowa Department of Education

Middle School Session –Facilitator Plan
Year 1 - Day 3

Content Goal:
NCTM Algebra Standards
Represent and analyze mathematical situations and structures using algebraic symbols

Process Focus:
Reasoning and Proof
Select and use various types of reasoning and methods of proof

Overall Teaching Goal: Teaching and learning mathematics through problem solving

Activity	Description for Facilitator	Time (Min)	Teacher Masters (TM) & Materials
1. Welcome and Opening Activity	1. Goals 2. Overview of year one 3. Overview of day three	10	**TM 1:** Year One Outline **TM 2:** Daily Overview **TM 3:** Year One Day 3 Agenda • TeachTimer
2. Process Homework	1. Discuss Principle Focus – Connection 2. In table groups answer the question "How does this process standard affect the curriculum, instruction, and assessment in middle school mathematics?" 3. Share few ideas from each team with the whole group	20	**TM 4:** Homework Analysis I **TM 5:** Notes on Homework Analysis I Notes • Principles and Standards for School Mathematics (PSSM) • PSSM Quick Reference Guide • Teaching Mathematics through Problem-Solving
3. Meaningful Distributed Practice	1. Participants do some MDP activities. 2. Review Components of Meaningful Distributed Practice. 3. Have each table review the MDP activities individuals brought and decide on one to develop more fully as a group 4. Have each group	85	**TM 6:** Sample MDP Activities **TM 7:** MDP Components **TM 8:** MDP template

Activity	Description for Facilitator	Time (Min)	Teacher Masters (TM) & Materials
	develop three days worth to share with group 5. Have each group share the ones they developed and explain the rationale for their choices. 6. Have discussions on ways these could be changed or adapted for specific situations. 7. Each group should finish five or six MDP activities to turn in for future sharing.		
4. Problem-Based Instructional Task	1. Pass out algebra tiles and explain what the pieces represent. 2. Launch • Demonstrate placing factors on the array frame with the factors (x + 3) and 2. • Fill in the array • Repeat using similar products 3. Explore • Present problem (x+3) (x+2) to the students and have them show the factors on their array frames along with the arrays. • Present problem (x+4) (x+1) and have students model and then share solutions with group. Ask them to find the factors • Have students make up problems for others and share	90	**TM 9**: Lesson Plan **TM 10:** Array Frame • Algebra tiles • Overhead Algebra tiles • Overhead Array frame

Activity	Description for Facilitator	Time (Min)	Teacher Masters (TM) & Materials
	with rest of class 4. Summarize and Clarify • Work with (x+5) (x+2) • Have participants just look at factors and indicate the product. • Discuss relationship of model with FOIL (first, outside, inside, last) method of multiplying polynomials		
5. Process Homework	1. Give each table a piece of paper with the number 1, 2, or 3 on the top. Have table discussions on the numbered question assigned to their table. Write down responses on the chart paper. 2. Pass the paper to a table with a different number. Review the comments by the first group and add on additional thoughts. 3. Pass the paper to a table that has not had the number on top of the paper and, once again, review the comments made by the first two groups and add any additional thoughts. 4. Do a brief summary as a whole group	30	**TM 11:** Homework Analysis II **TM 12:** Notes on Homework Analysis II Notes • Chart paper • Markers • Principles and Standards for School Mathematics (PSSM) • PSSM Quick Reference Guide

Activity	Description for Facilitator	Time (Min)	Teacher Masters (TM) & Materials
6. Strategies for helping LD Students		20	**TM 13** How Students Think **TM 14:** Notes on How Students Think **TM 15:** Response Sheet for *"Strategies for Helping Students Who Have Learning Disabilities in Mathematics."* **TM 16:** Notes on *"Response Sheet for "Strategies for Helping Students Who Have Learning Disabilities in Mathematics."* **TM 17**: "Classroom Activities for Students with Learning Problems." **TM 18:** Additional Thoughts on "Classroom Activities for Students with Learning Problems" • Steele, Marcee. "Strategies for Helping Students who have Learning Disabilities in Mathematics." Mathematics Teaching in the Middle School. Volume 8 No. 3 (November 2002):140-143.
7. Peer Coaching	1. Review components of peer coaching. Refresh memories that this model is not a "traditional" peer coaching method – rather peer partner and peer support. A big part of this model is planning together and watching each other teach. When one person observes another teach, the person teaching is doing	25	• Showers, Bev and Bruce Joyce. "The Evolution of Peer Coaching." Educational Leadership. (March, 1996):12-16. • Either a video of a peer coaching session or a script the instructors plan to use to simulate session

Activity	Description for Facilitator	Time (Min)	Teacher Masters (TM) & Materials
	the coaching. 2. Have participants review the key points of "The Evolution of Peer Coaching" by Showers & Joyce. 3. Model a peer coaching session – either by having the instructors modeling a session or by taping some teachers having a peer coaching session.		
8. Closure	1. Review TM 1– Overview – goals and activities of the day using 2. Review Homework assignment for next meeting 3. Pass out Evaluation form	5	**TM 1**: Overview **TM 19**: Assignment **TM 20**: Evaluation

Facilitator's Tool for Planning the Session

What is the background reading?

- Read: Chapter 1 in Teaching Mathematics Through Problem Solving (pp. 3 – 13)
- Read about reasoning (PSSM pp. 262 - 267)
- Design Meaningful Distributed Practice activities to share at next class

What equipment and materials should **participants** bring?

What Teaching Masters need to be copied?

Handouts:

For Participants
TM 1: Year One Outline
TM 4: Homework Analysis I
TM 7: MDP Components
TM 8: MDP template
TM 10: Array Frame
TM 11: Homework Analysis II
TM 15: Response Sheet for *"Strategies for Helping Students Who Have Learning Disabilities in Mathematics."*
TM 17: "Classroom Activities for Students with Learning Problems."
TM 19: Assignment
TM 20: Evaluation
For Participants AFTER the activities
TM 6: Sample MDP Activities
TM 9: Lesson Plan

What Teaching Masters need to be copied for presenters?

TM 1: Year One Outline
TM 2: Daily Overview
TM 3: Year One Day 3 Agenda
TM 4: Homework Analysis I
TM 5: Notes on Homework Analysis I Notes
TM 6: Sample MDP Activities
TM 7: MDP Components
TM 8: MDP template
TM 9: Lesson Plan
TM 10: Array Frame

TM 11: Homework Analysis II
TM 12: Notes on Homework Analysis II Notes
TM 13 How Students Think
TM 14: Notes on How Students Think
TM 15: Response Sheet for *"Strategies for Helping Students Who Have Learning Disabilities in Mathematics."*
TM 16: Notes on *"Response Sheet for "Strategies for Helping Students Who Have Learning Disabilities in Mathematics."*
TM 17: "Classroom Activities for Students with Learning Problems."
TM 18: Additional Thoughts on "Classroom Activities for Students with Learning Problems"
TM 19: Assignment
TM 20: Evaluation

Teaching supplies/materials/technologies

· Algebra tiles
· Overhead Algebra tiles
· Overhead Array frame
· Principles and Standards for School Mathematics (PSSM)
· PSSM Quick Reference Guide
· Teaching Mathematics through Problem-Solving
· TeachTimer
· Chart paper
· Markers
· Showers, Bev and Bruce Joyce. "The Evolution of Peer Coaching." Educational Leadership. (March, 1996):12-16.
· Steele, Marcee. "Strategies for Helping Students who have Learning Disabilities in Mathematics." Mathematics Teaching in the Middle School. Volume 8 No. 3 (November 2002):140-143.
· Video of a peer coaching session or a script the instructors plan to use to simulate session

Activity 1: Welcome and Opening Activity

Time: 10 minutes

Overview and Rationale:
This activity connects the day with the goals for the year. It will provide an opportunity to relate daily activities to the year-long goals and activities.

Conducting the Activity:

1 Goals
- Remind participants of the big picture for the year
- Point out where we've been and where we're going
- Emphasize the NCTM Content Standards and Process Standards of the day

2 Go through Year 1 Day 3 Agenda handout
- Briefly go through agenda
- Remind participants of the main themes of Every Student Counts
- Point out how those themes will be applied to the goals and focus areas
- Use the Quick Reference Guide to locate the NCTM Standards being highlighted

Materials
TM 1: Year One Outline
TM 2: Daily Overview
TM 3: Year One Day 3 Agenda

- TeachTimer

TM 1

Year One Outline
2004-2005

	Day 1 September 14/15	Day 2 October 26/27	Day 3 February 1/2	Day 4 April 26/27
NCTM Content Standard	Algebra	Algebra	Algebra	Algebra
	Understand patterns, relations, and functions	Understand patterns and functions	Represent and analyze mathematical situations and structures using algebraic symbols	Represent and analyze mathematical situations and structures using algebraic symbols
NCTM Content Standard 2		Algebra		Algebra
		Represent and analyze mathematical situations and structures using algebraic symbols		Analyze change in various contexts
Mathematical Activities	Represent, analyze, and generalize patterns with tables, graphs, words, symbolic rules Relate and compare different representations for relationships Explore linear and nonlinear functions	Relating data and building goals to distributed practice Distributed Practice Development Patterns and Functions Standards-based mathematics classroom	Problem solving relating algebra to concrete representations Modeling and Solving Problems using Technology	Discuss Working Inside the Black Box Representing and Analyzing mathematical situations using symbols Special Education connections Modeling and Solving Problems using Technology
NCTM Process Standard	Representation	Connections	Reasoning and Proof	Problem Solving
Assessment		Review post-test data		Working Inside the Black Box
Technology/ Manipulative Tools		VCR	Graphing Calculator	Graphing Calculator

TM 2

Every Student Counts means . . .

Teach for Understanding and Focus on Meaning

Problem-Based Instructional Tasks Teaching through Problem Solving	Meaningful Distributed Practice of Concepts, Skills, & Problem Solving

Today's Goals . . .

Content Goal: Algebra
Process Goal: Reasoning and Proof

Today's Objectives . . .

- *Represent and analyze mathematical situations and structures using algebraic symbols*

TM 3

Agenda – Year 1 Day 3
Middle Grades Session

Goals:

1. Algebra Standard: Represent and analyze mathematical situations and structures using algebraic symbols
2. Reasoning and Proof standard

Agenda:

1. Welcome and Opening Activity
2. Process Homework
3. Meaningful Distributed Practice
4. Problem-Based Instructional Task
5. Process Homework
6. Meaningful Distributed Practice Sharing
7. Peer Coaching
8. Closure

Activity 2: Process Homework

Time: 20 minutes

Overview and Rationale:
This activity ties the homework into the work the participants are doing in and out of sessions.

Conducting the Activity:
Divide each table into three discussion groups. Each group discusses one of the following Homework Analysis I questions and then shares thoughts with the rest of their table. After table discussions, highlights are shared with entire group.

- What does it mean to "understand" mathematics? (Teaching Mathematics Through Problem-Solving, Chapter 1)
- In what ways can classrooms be designed to promote understanding? (Teaching Mathematics through Problem-Solving, Chapter 1)
- What are the biggest differences between traditional classrooms and those in which problem-solving is used as the means to teach understanding? (Teaching Mathematics through Problem-Solving, Chapter 1)

Materials:
TM 4: Homework Analysis I
TM 5: Notes on Homework Analysis I Notes

- Principles and Standards for School Mathematics (PSSM)
- PSSM Quick Reference Guide
- Teaching Mathematics through Problem-Solving

TM 4

Every Student Counts
Middle School Homework Analysis I

1) What does it mean to "understand" mathematics?
   (Teaching Mathematics Through Problem-Solving, Chapter 1)

2) In what ways can classrooms be designed to promote understanding?
   (Teaching Mathematics through Problem-Solving, Chapter 1)

3) What are the biggest differences between traditional classrooms and those in which problem-solving is used as the means to teach understanding?
   (Teaching Mathematics through Problem-Solving, Chapter 1)

TM 5

Notes on Middle School Homework Analysis I

1) **What does it mean to "understand" mathematics? (Teaching Mathematics Through Problem-Solving, Chapter 1)**
   - Students must get inside topics, get curious about how things work, figure out how things are alike and different, become confident in their ability to solve problems
   - When one understands a topic, one will remember things when one needs them
   - A person will use what they know flexibly to handle new situations
   - Understanding something is fun.

2) **In what ways can classrooms be designed to promote understanding? (Teaching Mathematics through Problem-Solving, Chapter 1)**

   - Understanding is supported best through a delicate balance among engaging students in solving challenging problems, examining increasingly better solution methods, and providing information for students at just the right time.
     - Allow students to do more of the mathematical work.
   - Signpost 1: allow mathematics to be problematic for students
     - Have students figure out extensions of problems
     - Allow routine exercises to be problems
     - Students must engage in the problem if it is to be problematic
   - Signpost 2: Focus classroom activity on the methods used to solve problems
     - Students need to have time to share the methods they used to solve a problem.
     - Students listen to alternative solutions.
     - Analyze the strengths and weaknesses of the different solutions – searching for more effective solution.
     - Students need to analyze how they can explain and justify their solution to the other students.
     - Classroom conversations should revolve around sharing, analyzing, and improving methods.
     - Focus should be on the merit of the method
       - First benefit of examining methods is that it encourages students to construct mathematical relationships, and constructing relationships is at the heart of understanding.
       - Second benefit of focusing on methods is that students can learn from analyzing a range of methods.
   - Signpost 3: Telling the right things at the right times
     - What information should the teacher present and when should they present it?
       - Presenting too much information too soon removes the problematic nature of problems.
       - Presenting too little information can leave students floundering

- Rule of thumb 1) Teachers can and should show students the words and written symbols that are commonly used to represent quantities, operations, and relationships – social convention
    - Present when children need them – when the ideas have been developed and they need a way to record the ideas and communicate with others about them
- Rule of thumb 2) Teachers can present alternative methods of solutions that have not been suggested by students.
    - Teachers should present solutions that they know will be helpful for the students (help understand the main idea and relationships)
    - Trick is for the teacher to present the method just as one the students should examine.
- Rule of thumb 3) Teachers should highlight ideas that are embedded in students' methods.
    - This shows respect for student thinking
    - It helps focus students' attention on the important mathematics

3) What are the biggest differences between traditional classrooms and those in which problem-solving is used as the means to teach understanding? (Teaching Mathematics through Problem-Solving, Chapter 1)

- Classroom Practice will be achieved by two issues
    - What learning goals we set for students
        - Traditional goals must be <u>expanded and reshaped</u> to include a deep and rich understanding of math
    - How students can best achieve these goals
        - Make mathematics problematic for the students
        - Need to struggle to understand
        - Struggling, in a positive sense, prepares students to make sense of relevant information, to piece together things in new ways, and to see the benefits of better methods of solution.
        - Deep understanding develops over time, so work on problems must be extended

Activity 3: Meaningful Distribute Practice

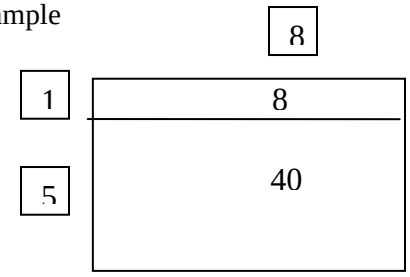
Time: 85 minutes

Overview and Rationale:

This activity provides examples and discussion of meaningful distributed practice. Meaningful distributed practice is one of the main components of the Every Student Counts program. Participants have an opportunity to develop their own MDP activities.

Conducting the Activity:

1. Participants do some MDP activities.
    a. Remind participants that arrays are always rectangles. Have them do MDP #1 as a simple base ten arithmetic example



    b. Move to MDP # 2 having them share different possible ways to split this rectangle. Compare it to the algorithm (e.g. 8 times 10 = 80 added to 5 times 8 = 40 translates to 80 + 40 = 120.)
    c. On MDP #3 show several ways to split the rectangle (10 and 6 by 5 and 20) or (4 and 4 and 4 and 4 by 25.)
    d. MDP #4 and #5 can be used to go into fraction multiplication. Have students draw these models and then discuss them.
2. Review Components of Meaningful Distributed Practice
3. Emphasize that MDP planned items could be changed as needed based on students' responses. Harder questions could be asked for students who understand the concepts and more supportive questions could be designed for students struggling with the concepts.
4. Have participants begin to write their own MDP activities.
    a. Have each table review the MDP activities individuals brought and decide on one to develop more fully as a group
    b. Have each group develop three days worth to share with group
    c. Have each group share the ones they developed and explain the rationale for their choices.
    d. Have discussions on ways these could be changed or adapted for specific situations.

Materials:

TM 6: Sample MDP Activities
TM 7: MDP Components
TM 8: MDP template

TM 6

Participant _____ Grade Level 5-7

Organization DE

Big Idea(s)

Number Sense – Understand meanings of operations and how they relate to one another

Algebra – Use mathematical models to represent and understand quantitative relationships

Distributed Practice and Questions:

1. The teacher presents the multiplication fact 6 x 8 and has the students draw a rectangle with those dimensions.

QUESTIONS:

- How could you find the area of this rectangle if you did not know what 6 x 8 was?
- Split it into two pieces both of whose area is easy to determine. How did you split it?

2. The teacher presents a 8 x 15 rectangle.

QUESTION:

- How could you find the area of this rectangle by splitting it into parts?
- Share how you split it.

3. The teacher presents a 16 x 25 rectangle.

QUESTIONS:

- How could you find the area of this rectangle by splitting it into parts?
- Share how you split it.

4. The teacher presents a 1 x 15 rectangle.

QUESTIONS:

- The area of this rectangle is 15 sq. units.
- Now divide the "1" side into thirds and shade in one of the three equal regions. This represents 1/3 x 15. What is the area of this section?

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5. The teacher asks the students to draw an array which represents 2/3 x 3/4, starting with a 1 x 1 square.

QUESTIONS:

- How can you find this product by looking at the array? Share your thinking.

TM 7

Meaningful Distributed Practice of Concepts, Skills and Problem-Solving

- Targets an identified need based on multiple data sources
- Helps students develop a deep understanding of a *Big Idea*
- Helps students develop flexibility and fluency with skills and concepts
- Builds on and extends understanding
- Uses problems and activities that help students learn to use multiple representations and learn to use multiple reasoning strategies
- Uses problems from a variety of contexts so students learn to make connections.

TM 8: ***Distributed Practice, Questions, and Assessment:*** Grade Level/Class _____
Big Idea(s) _____

Day One	Day Two	Day Three
Activity 1	Activity 2	Activity 3
Questions:	Questions:	Questions:

Day Four	Day Five	Day Six
Activity 4	Activity 5	Activity 6
Questions:	Questions:	Questions:

Activity 4: Problem-Based Instructional Task

Time: 90 minutes

Overview:

This activity provides examples and discussion of a problem-based instructional task. PBITs are one of the main components of the Every Student Counts program, along with Teaching for Understanding and Meaningful Distributed Practice.

Conducting the Activity:

1) Pass out algebra tiles and explain what the pieces represent.
2) Launch
   a) Demonstrate placing factors on the array frame with the factors (x + 3) and 2.
   b) Fill in the array
   c) Repeat using similar products
3) Explore
   a) Present problem (x+3) (x+2) to the students and have them show the factors on their array frames along with the arrays.
   b) Present problem (x+4) (x+1) and have students model and then share solutions with group. Ask them to find the factors
   c) Have students make up problems for others and share with rest of class
4) Summarize and Clarify
   a) Work with (x+5) (x+2)
   b) Have participants just look at factors and indicate the product.
   c) Discuss relationship of model with FOIL (first, outside, inside, last) method of multiplying polynomials

Materials:

TM 9: Lesson Plan
TM 10: Array Frame

- Algebra tiles
- Overhead Algebra tiles
- Overhead Array frame

TM 9

Problem-Based Instructional Task Sample Lesson Plan

Lesson Topic: Algebra Tiles
Grade Level/Course: 6th
Objective: Students will learn to represent algebraic products using algebra tiles
Pre-requisite Knowledge: Arrays, algebra tiles notation
NCTM Standard(s): (shaded)

NCTM Content Standards →	Number & Operations	**Algebra**	Geometry	**Measurement**	Data Analysis & Probability
NCTM Process Standards →	Problem Solving	Reasoning & Proof	**Communication**	**Connections**	**Representation**

Materials Needed:

Audio-visual: Overhead algebra tiles
Manipulatives: Algebra tiles, array frames
Literature:
Technology/Software:
Other:

Opening Distributed Practice:

Distribute the algebra tiles to the students. Each piece represents either a variable, x ,or individual numbers, like 4 or 7. Decide what each piece should be called. Justify your answers. Have students share their answers. Clarify any misconceptions. In the following days, the students can be asked to represent various values using their tiles.

Examples:

- Show 2x + 3 using your tiles.
- Show 3x + - 4 using your tiles.
- Show x^2 - 4x +2.

Main Lesson Development:

Launch: To show a product using the algebra tiles, place one factor to the left side of the array frame and the other above the array frame. Agree on a consistent representation: the first factor is placed along the left side and the second factor along the top.

Demonstrate using the factors (x + 3) and 2. Ask the students to represent these factors and then determine the product by filling in the array with the appropriate tiles. The resultant product must be in the form of a rectangle.

Place 3(x + 4) on the array frame. Then fill in the array. Ask the students to write down what product is represented. Repeat using similar products (one factor containing x plus a constant, the factor other a single constant).

Explore: Present the problem (x + 3)(x + 2) to the students. Have them show the factors on their array frame along with the array that represents the product. Check to see if they include all the partial products (x^2 + 2x + 3x + 6) in the array. Have them look back at the factors and indicate where all the partial products came from.

Present the problem (x + 4)(x + 1). Have the students represent the situation and determine the product.

Share: Select a students to come to the overhead and show how they determined the partial products for (x + 4)(x + 1). Ask the student if he/she can identify what the product would be by just looking at the terms in the factors. Ask others in the class for help if needed. Have the student make up another problem for the rest of the class to represent. Share the results. These explanations can form the basis for demonstrating the FOIL method to the students.

Summarize and Clarify: Present the factors (x + 5)(x + 2) to the students. Ask them to indicate what they think the product would be by looking at the factors. Have someone indicate where each of the partial products came form. Introduce the FOIL method and point out where each result is in the array represented. (F)irst is the x^2 term, (O)uter is 2x, (I)nner is 5x, (L)ast is 10.

Modifications/Extensions: Present the problem (2x + 2)(3x +1) to the students. Have them represent the factors and the product. Have the students refer back to the factors and indicate where each partial product comes from and how it relates to FOIL.

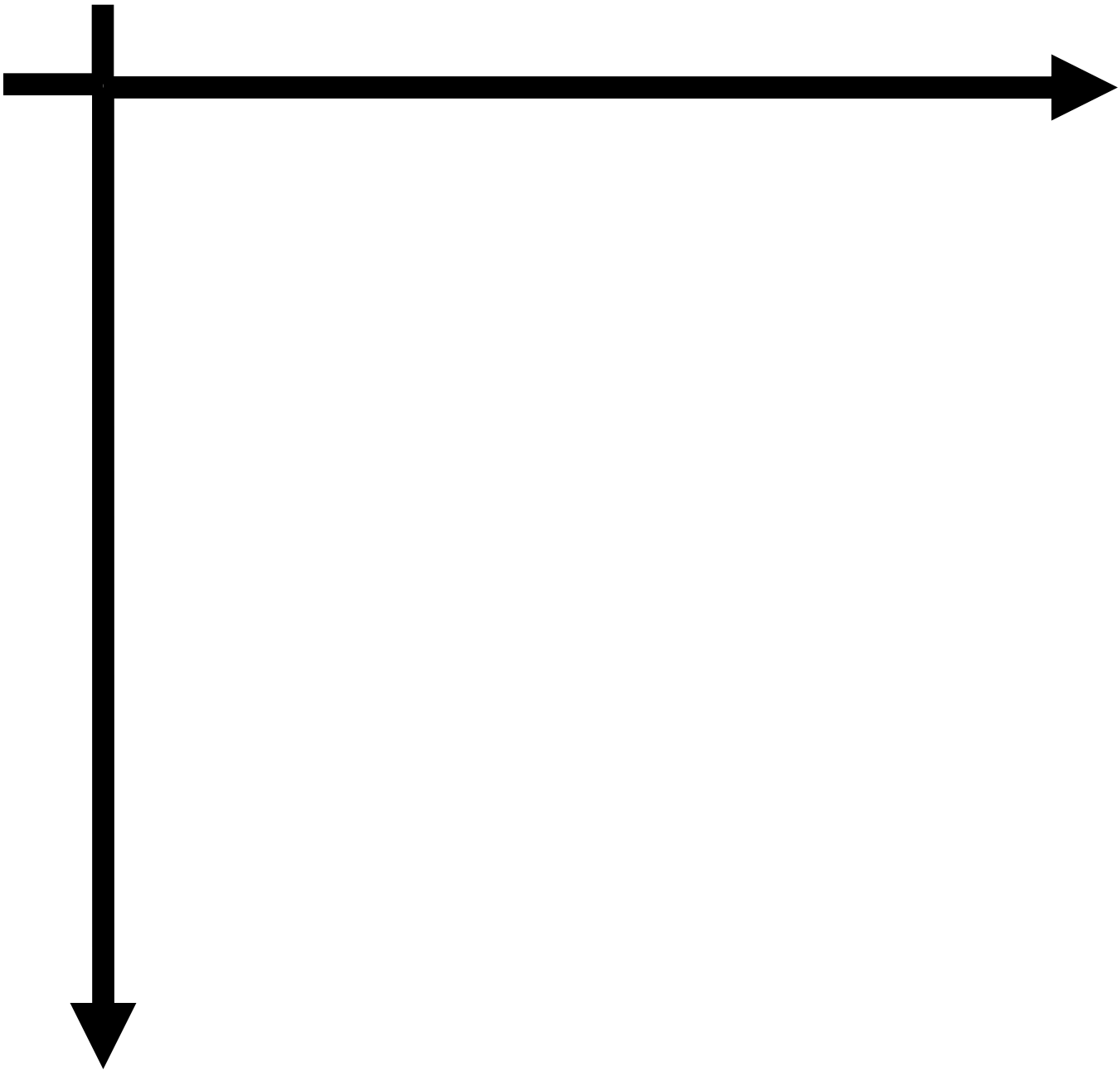
Have the students represent the product, $x^2 + 7x + 6$, inside the array frame. Then have them determine the factors that would result in that product. Encourage them to check to make sure all the partial products are appropriate. Ask a student to explain how he/she determined the factors. Repeat with $2x^2 + 4x + 2$.

TM 10

Algebra Tiles

$$(2X - 2)(X + 3)$$

$$= 2X^2 + 6X - 2X - 6$$



Activity 5: Process Homework

Time: 30 minutes

Overview and Rationale

Process homework. This homework relates the Reasoning and Proof Standard to the Every Student Counts work.

Conducting the Activity

1) Give each table a piece of paper with the number 1, 2, or 3 on the top. Have table discussions on the numbered question assigned to their table. Write down responses on the chart paper.
   a) How does mathematical argument at the middle school level compare and contrast with formal mathematical proof?
      (PSSM, p. 262 – 267)
   b) What are some things that middle school students can do to begin the development of mathematical arguments?
      (PSSM, p. 262 – 267)
   c) What is the teachers' role in helping middle school students develop mathematical arguments?
      (PSSM, p. 262 – 267)
2) Pass the paper to a table with a different number. Review the comments by the first group and add on additional thoughts.
3) Pass the paper to a table that has not had the number on top of the paper and, once again, review the comments made by the first two groups and add any additional thoughts.
4) Do a brief summary as a whole group

Materials

TM 11: Homework Analysis II
TM 12: Notes on Homework Analysis II

- Chart paper
- Markers
- Principles and Standards for School Mathematics (PSSM)
- PSSM Quick Reference Guide

TM 11

Every Student Counts

Middle School Homework Analysis II

1) How does mathematical argument at the middle school level compare and contrast with formal mathematical proof? (PSSM, p. 262 – 267)

2) What are some things that middle school students can do to begin the development of mathematical arguments? (PSSM, p. 262 – 267)

3) What is the teachers' role in helping middle school students develop mathematical arguments? (PSSM, p. 262 – 267)

TM 12

Notes on Middle School Homework Analysis II

1) **How does mathematical argument at the middle school level compare and contrast with formal mathematical proof? (PSSM, p. 262 – 267)**
   - In middle school, reasoning consists of
     - examining patterns
     - noting regularities
     - making conjectures about possible generalizations
     - and evaluating the assertions and conjectures
     - using inductive and deductive reasoning to formulate math arguments (construct and evaluate mathematical arguments)
       - Use inductive reasoning to search for mathematical relationships through the study of patterns
   - Arguments contrast with formal arguments in the following ways:
     - Formulating a plausible conjecture
     - Testing the conjecture
     - Display the associated reasoning for evaluation by others

2) **What are some things that middle school students can do to begin the development of mathematical arguments? (PSSM, p. 262 – 267)**

   - Use inductive reasoning to reach a generalization
   - Note regularities
   - Formulate a conjecture
   - Develop and discuss a convincing argument

3) **What is the teachers' role in helping middle school students develop mathematical arguments? (PSSM, p. 262 – 267)**

   - Foster a mathematically thoughtful environment
     - engage students in thinking and reasoning in the classroom
   - Create and select tasks that are appropriate to ages and interests of middle-school students
     - Choose tasks that call for reasoning to investigate mathematical relationships.
     - Choose problems that require the generation and organization of data to make, validate, or refute a conjecture.
   - Monitor students developing facility with reasoning
     - Be sure to show limitations of inductive reasoning
     - Show complexities of deductive reasoning

Activity 6: Strategies for helping LD

Time: 20 minutes

Overview and Rationale This sections hows how teachers can work with the special education students.

Conducting the Activity

1. Introduce idea of working with LD students with "How Students Think"
2. Think/Pair/Share for article "Strategies for Helping Students who have Learning Disabilities in Mathematics"
   - Read 8 to 10 minutes independently using response sheet
   - Talk to a partner about your personal responses
   - Have general discussion as whole group.
3. Form groups of three grade-level groups
   - Answer the question, "What things in ESC could be used to address strategies?"
   - Use **"**Classroom Activities for Students with Learning Problems" to relate ESC to ideas presented in the article
4. Have whole group discussion of strategies. If no one comes up with the ideas, share ideas from "Additional Thoughts on *Classroom Activities for Students with Learning Problems"*

Materials

TM 13 How Students Think
TM 14: Notes on How Students Think
TM 15: Response Sheet for **"***Strategies for Helping Students Who Have Learning Disabilities in Mathematics.***"**
TM 16: Notes on **"***Response Sheet for "Strategies for Helping Students Who Have Learning Disabilities in Mathematics***."**
TM 17: "Classroom Activities for Students with Learning Problems."
TM 18: Additional Thoughts on "Classroom Activities for Students with Learning Problems"

- Steele, Marcee. "Strategies for Helping Students who have Learning Disabilities in Mathematics." Mathematics Teaching in the Middle School. Volume 8 No. 3 (November 2002):140-143.

TM 13

How Students Think

- Some don't bother to think
- Some think like they think you want them to think
- Some think exactly like you want them to think
- Some think for themselves

TM 14

Notes on How Students Think

- Some don't bother to think
  - Sometimes special education students think all of mathematics is probability.
  - Moving these students forward may start with some step-by-step procedures; but they can then be guided to develop graphic organizers for their thinking.
- Some think like they think you want them to think
  - Some special education students have an external locus of control and don't think they have control over whether or not they will understand things.
- Some think exactly like you want them to think
  - This would be enhanced by doing Think Alouds (Do I add or subtract in this problem? Why did I make this choice?)
- Some think for themselves
  - This is where the Problem-based Instructional Task is the most helpful. Students have time to think about a problem, but there is time also for sharing and clarifying, so they don't get too far off base.

TM 15

Response Sheet
For
Strategies for Helping Students Who Have Learning Disabilities in Mathematics

1. What particular aspects of this article would you find useful in your setting? Why?

2. Was there anything you took exception to in the article or had a question about? What was it and why?

TM 16

Notes on Response Sheet For *Strategies for Helping Students Who Have Learning Disabilities in Mathematics*

- Characteristics of LD
  - Processing
  - Difficulty not brought on by another disability
  - Discrepancy between potential and performance
    - Memory deficiencies
    - Processing problems
      - Auditory
      - Visual
      - Motor
    - Abstract reasoning deficits
    - Organizational deficiencies
    - Social, emotional, and behavioral issues
- Interventions
  - Advance organizers
    - Overview
    - Brief outline
    - Discussions of daily=life applications
    - Overviews of the types of problems to be solved
  - Review prerequisites
  - Modeling steps of problem
  - Step-by-step procedures
  - Guided and independent practice
  - Feedback
  - Generalizing must be taught directly
  - Connect instruction to life-skills
  - Focus on fundamental ideas
  - Mnemonic strategies
  - Self-monitoring and self-questioning
  - Visual aids
  - Teaching more concretely
  - Cooperative learning

TM 17

Classroom Activities for Students with Learning Problems

- Present advance organizers and review prerequisite skills or concepts

- Model procedures enough times for clarity and teach and practice the use of usual aids

- Use real-life and meaningful examples and focus on essential ideas for connections and foundations

- Teach the skill of generalization specifically and directly and teach self-questioning and self-monitoring

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Additional Thoughts on

Classroom Activities for Students with Learning Problems

Compare the components of PBIT and MDP with the statements above and all will correlate with one or more of the components. The thoughts below are things that should be avoided when working with LD students:

- Don't fixate on answer getting
  - Counting the number of digits correct is not a helpful tool for increasing understanding.

- Don't present symbols too quickly
  - Use diagrams or pictures
  - Books often use symbols too quickly
  - Use manipulatives to model problems
  - Ask students to show another way if they use symbols to check understanding
    - Example: a student being interviewed was given the problem 70 – 53. She solved the problem symbolically and got 23 for an answer. The teacher asked her to solve it another way. She used manipulatives and got 17. When asked which answer was correct, she said 23 was correct. She was then given a 100 chart and modeled taking 53 from 70. Once again she got 17 as an answer. She STILL said that 23 was the correct answer because the way she solved it was "math".

- Don't just cover pages in the textbook

- Don't introduce topics cold
  - Rather than reviewing, preview skills needed to do the task. This can be done with MDP activities, in whole group, if needed, or in private session with the child so s/he can become the "expert."
- Don't over emphasize summative assessment
  - Be sure to pay attention to formative assessment to see how students are progressing. This can be done by questioning, writing, spot checking or short quizzes.

- Don't focus on short term solutions
  - Try to develop skills and concepts that pay off in the long run. Having the students memorize tricks to solve problems does not give them the tools needed to use the ideas they are learning in out-of-school activities.
- Don't avoid thinking about thinking.
  - Think about what makes these students successful and build on that.

Activity 7: Peer Coaching

Time: 25 minutes

Overview: This activity shows how the collaborative component of ESC moves things forward.

Conducting the Activity

1 Review components of peer coaching. Refresh memories that this model is not a "traditional" peer coaching method – rather peer partner and peer support. A big part of this model is planning together and watching each other teach. When one person observes another teach, the person teaching is doing the coaching.
2 Have participants review the key points of "The Evolution of Peer Coaching" by Showers & Joyce.
3 Model a peer coaching session – either by having the instructors modeling a session or by taping some teachers having a peer coaching session.

Materials

- Showers, Bev and Bruce Joyce. "The Evolution of Peer Coaching." Educational Leadership. (March, 1996):12-16.
- Either a video of a peer coaching session or a script the instructors plan to use to simulate session

Activity 8: Closure

Time: 5 minutes

Overview: This activity ties the day together.

Conducting the Activity

1 Review TM 1– Overview – goals and activities of the day using
2 Review Homework assignment for next meeting
3 Pass out Evaluation form

Materials
TM 1: Overview
TM 19: Assignment
TM 20: Evaluation

TM 19

ASSIGNMENTS FOR DAY THREE

1. Problem Solving Green Book – Chapter 2 (pp. 20 –25)
2. Problem Solving Standard (pp. 256-261)
3. Black, P. and Wiliam, D. "Working Inside the Black Box." Phi Delta Kappan. (September, 2004):9-21.

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Every Student Counts

Participant Feedback **Date:**

What is your primary role?

_____AEA Team _____Urban 8 District Team

What were your key learnings from this session?

What questions do you have about the information and content presented and discussed during this session?

What considerations and concerns do you have about your individual use and follow-through of the information presented and discussed this session?

What considerations and concerns do you have about your team use and follow-through of information presented and discussed this session?